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POPULATION SIZE AND CONSERVATION OF *Lipotes vexillifer*

By

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Translated by C.H. Perrin
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In recent years, there have been several articles (Zhou Kaiya et al. 1958, 1977, 1980, 1983) about the baiji (Lipotes vexillifer) in the Chang Jiang (Yangtze River) concerning its distribution and population size. The contents of these articles are usually limited to the results of one or two field trips covering only certain sections of the Yangtze River where baiji appear frequently. None of these studies has dealt in depth with the baiji's overall distribution and population size in the Yangtze River. During the period from December 1978 until January 1983, we made nine ecological expeditions in the middle and lower reaches of the river (Yichang to Nantong). We also surveyed in the Han River, Poyang Lake and Dongting Lake. Based on our studies and observations, we present a preliminary analysis of the distribution, population size and population structure of the baiji in the Yangtze River. Measures to conserve the baiji are also recommended in this report.

1. POPULATION DISTRIBUTION AND ABUNDANCE ESTIMATION

The results of our observations show that baiji are mainly distributed along the main channels of the middle and lower reaches of the Yangtze River. The uppermost place in the middle reach where the baiji can be seen is near Zhicheng in Hubei Province, which is about 1613 km from the mouth of the river, and the lowest point in the lower reach is Taicangliuhe in Jiangsu Province, which is 24 km from the mouth.

The Yangtze River is wide and open in the middle and lower reaches. The water is calm, and current speed is 1 - 2 meters per second. There are many sand bars. Numerous tributaries connect the river with surrounding lakes. During the dry season, the lowest end (referring to the direction of the current flow) of a sand bar rises above the water level and forms a wide beach area where grasses and weeds grow thickly. During the rainy seasons, the sand bars are all submerged, and plant life grows vigorously, providing subsistence for fish. Among the sandbars, the river course and water speed vary drastically. Stones and rocks are scattered at each end of the sand bars. The current turns when running into the rocks and forms a counter current at the lower end of the sand bar, creating a special living environment. Fish are most abundant in these waters, and fishermen fish here year-round. Baiji feed on fish, therefore they are very active at these places (Figure 1).

We began to research the distribution and abundance of baiji using the results of our investigation and with reference to the reports by Zhou Kaiya et al. (1958, 1977, 1980, 1983), Chen Peixun et al. (1980), Yao Wenqin et al. (1974), and Chen Yiyu et al. (1975).

The research vessels we used were Marine 1 and Marine 2, which belong to the Institute of Hydrobiology at Wuhan, and the Kehu, a research vessel from the Nanjing Geology Institute. During the investigation, the research vessel moved at 10 - 12 km per hour. Observers with and without binoculars searched the water surface. Baiji were spotted when they came to the surface to breathe. While the vessel was pursuing the animals, the researchers recorded the estimated number of baiji, the time and the place. Baiji are commonly seen in schools, and individual baiji were not separated far from each other. Due to the very large surface area to be covered, frequent stopovers at night, and bad weather, naturally we missed some dolphins. Therefore these sighting records do not reflect the actual population size. However, we used the following method to estimate the population size and the number of sub-populations. We took all nine sets of survey records and marked the frequency of sightings along the river (occurrence frequency). This showed certain dense areas along the middle and lower reaches of the river. These places have well developed sandbars and provide the baiji with a good living environment. They should be the places that baiji frequent. Then we divided the main channel of the middle and lower reaches of the Yangtze river into 17 sections. (Figure 2). Theoretically, there is only one sub-population group in each section, but sections 5, 6, 10 and 11 are relatively longer than the rest of the sections. In these sections occurrences sometime were spread out and at other times clustered together. In these sections there are few sand bars, and we suspect that there is more than one sub-population in each. We elaborate this further as follows.

The fifth section can be divided into three sub-sections according to the general environment of the sand bars: Anqing, Tuqiou, and Heishazhou south. We sighted a group of baiji on both 19th and 20th of April, 1981 in the Anqing subsection (570 - 640 km from the mouth). We will call this group A. On the 21st we saw another group in Tuqiou subsection (490-560 km from the mouth). It was not likely that the same group of baiji would swim back and forth and follow us for 3 days and for 150 kilometers. Therefore we believe the group we saw on the 21st was a different group. Let us call it group B. On the 6th and 7th of July 1981 we made a sighting of baiji at Heishazhou south (470 - 480 km from the mouth of the Yangtze River). Again on the 8th we saw a group in Tuqiou subsection. Following the same reasoning, we believe the group we saw on the 8th was group B, and the group at Heishazhou south was a third group, C. Therefore in the 5th section of the river there exist 3 sub-populations: A, B, and C.

The sixth section can be divided into two subsections: Dongliu and Anqing upper. On October 17th, 1981 we saw a single baiji at Anqing upper, and we noticed group activities at Dongliu a few times. With the information we have, we could not prove that the group in the Anqing upper subsection is another subgroup. Therefore we identify only one group in the sixth section of the Yangtze River.

In the 10th section of the river, there are 2 subsections: Jiayujia and Daxing. On the 17th of October 1981 we discovered one group at Jiayujia Beach (1,163 - 1193 km from the mouth of the Yangtze River). On the 13th and again on the 14th, we found another group at Youhu Beach (1,113 - 1,163 km). When we returned to Jiayujia Beach on the 15th, again a group was sighted. These two subsections are narrow and small in area; it probably was not the same group of baiji swimming back and forth through the narrow waterway, therefore we believe there are two sub-groups in this section.

Two subsections can be established in river section 11: Loushan to Yanlinyén and Xhintijepei. We do not have enough information to determine whether more than one group exists here. We will assume there is only one group in this section.

Summarizing all the above situations, we conclude that there are 20 sub-groups distributed among the 17 sections of the middle and lower reaches of the Yangtze River (Table 1.). Not many dead dolphins have been discovered during recent years in these sections of river, therefore we will use the highest sightings made after December, 1978 for each sub-group as its sub-population size. For sections that are wide and where sightings were limited to one or two dolphins, we used the average of the actual sighting numbers. Using this method, we conclude that the average sub-group size was 8 for sections 1, 2, 3, 4, 8, 9, 14, and 17 (Figure 1). Thus we get a total estimated population size

TABLE 1. Number of baiji in sections of the Changjiang.

SECTION	DISTANCE FROM MOUTH (km)	LOCALITY/ SUBSECTION	ESTIMATED NUMBER OF DOLPHINS
1	~24	Liuhe	8
2	240-275	Jiaoshan	8
3	330-360	Caoxieqia - Bauta	8
4	370-460	Wujiang - Jiangbeizhou	8
	470-640		
5	470-480	Heishazhou south	3
	490-560	Tuqiou	9
	570-640	Anqing	9
6	645-725	Anqing Upper	6
7	725-788	Dongbeizhi	4
8	915-980	Shazhou - Baishazhou	8
9	1,010-1,043	Yangluo	8
	1,113-1,193		
10	1,113-1,163	Daxing	11
	1,165-1,193	Jiayujia	13
11	1,203-1,268	Xinti - Xianfong	11
12	1,268-1,303	Guanyizhou-Chibakou	5
13	1,333-1,348	Zhuanqiao	6
14	1,373-1,393	Laijiapu	8
15	1,408-1,468	Xinzhou - Guanzhou	12
16	1,493-1,518	Ouchikou	3
17	1,583-1,618	Zhicheng - Guanzhou	8

of 156.

We point out the fact that we observed 2 - 3 sub-groups in section 5 and section 10. It appears that the baiji's occurrence is tightly associated with the existence of the sandbars. In the middle and lower reaches of the Yangtze river there are more than 20 places where sand bars exist. Baiji probably do exist in sections of the Yangtze River where no sightings were made. With this assumption, then there would be more than 20 sub-groups, and the total population size would be more than 156. Next we will explain the structure of the baiji population.

2. POPULATION STRUCTURE

The current estimated baiji population size remains 156, but its territory extends for 1,589 km. We need to find a reasonable method to estimate the current stock status and to predict changes in the future. Assuming mortality rates are the same for both sexes, we then use all the mortality information we have collected for the baiji along the Yangtze River to represent the current population sex ratio and age structure. We use these sample statistics to assess the population status, and further as a basis for conservation.

We have recorded all specimens collected between 1973 - 1983 along the middle and lower reaches of the Yangtze River, noting their locations, causes of death and sex. This sample consists of 33 adults and 3 fetuses. We estimated ages using the equation $y = x / (ax + b)$. This is based on the average male or female's body length in relation to age. The result would have some deviation from the actual age.

We can divide the age and body length regression curve of both sexes into the following four stages: I, the newborn and calf stage (fetus to 4 years for males; fetus to 5 years for females); II, the adolescent stage (5 -12 years for males; 6 - 13 years for females); III, the young adult stage (males from 13 - 20 years; females from 14 - 20 years), and IV, the old adult stage (20 years and above for both males and females). Those baiji in the second and the third stages possesses reproductive capabilities, while the first-stage animals serve as the replacements for the population, and the fourth stage dolphins are the aged. Out of these 33 specimens we discarded 3 for which we were not able to estimate ages. For the remaining 30 , percentage at each stage was as follow: I (42.42%), II (39.40%), III (15.15%), and IV (3.03%). From the sample age-stage structure we estimate that the total population counts for each stage are: 66, 61, 24, and 5.

Age structure is a very important index to future population trend. We use the age groups displayed in Figure 3 to show age structure. According to Smith and Fretwell (1974), a highly reproductive population should be a pyramid with a broad base and a narrow tip, which means a population with a large group of young and few aged.

The baiji has a population structure with a narrow base and a broad top. Obviously, it is not a highly reproductive population. Since the population structure possesses relative stability, the baiji was able to sustain itself in its present state.

Having a small population size, the baiji would be in imminent danger of extinction if reproductive rate declined and mortality rate increased. To protect the baiji from extinction is an urgent issue. In recent years, replacement and reproduction have been adversely affected because of exploitation and heavy utilization of the river. To depict the changes that have happened, we make a comparison between the two figures we have taken: current population size of 156, and population size prior to 1983 of 189 (this includes the 33 dead, but the newborns were excluded). Suppose the population's age structure does not vary, then the original counts for each age group are 80, 74, 28 and 7. In recent years, the death counts for each group are 14, 13, 5, and 1, a decrease that is not proportionally distributed among the age groups. We know from these figures that the disproportionate mortality rate changed the population age structure, which means the first group declined 11%, the second and the third groups declined 7%, and the fourth group on the contrary increased 82%. The reproducing group's mortality total represents 54.54% of the total population mortality, with the female group's mortality 1.5 times the male group. The young group's mortality is 42.42% of the total population mortality. We can see that the reproducing age group, which maintains the population at sustainable size, has the highest mortality rate. In consequence, the baiji's regenerating force and reproducing capability is confronted with a certain degree of destruction.

3. CAUSES OF THE DESTRUCTION OF THE BAIJI RESOURCE AND PREVENTATIVE MEASURES.

Based on our ecological investigations and collected specimen records, we analyzed the main reasons for the decline of the baiji.

1. The deterioration of food conditions

There are innumerable lakes along the middle and lower reaches of the Chang Jiang; fish feed in these waters that are rich in nutrients. Since portions of these lake have been closed and turned into farming areas, the total acreage of the lakes has been sharply reduced, e.g. the total figure of 12,500,000 mu in 1949 has decreased to 3,550,000 mu in 1977 (Jin Boxing, 1978). Construction of new dams and repair of old dams among the rest of

the lakes have interrupted the fish's feeding pattern and passage way, thus resulting in a serious damage to the the natural resource. Take Hung Lake, which is relatively rich with fish, as an example. Since construction started in 1956, the amount of fish the Fish Wholesale Department has purchased there has been sharply reduced at a yearly rate of 30%. Baiji mainly feed on fish; the reduction in production of fish in the lower and middle reaches of the Chang Jiang is very harmful to the baiji's population sustainability.

2. Deaths and injuries by fishing gear.

Capturing food is a important activity for any animal. Baiji capture fish. They are usually active in areas where fish are abundant. Unfortunately, these are areas where fishermen fish too. Fishermen along the channel of the Chang Jiang use rolling hooks as their primary fishing tool. This is a type of long-line system with a few hundred and sometimes even thousands of large hooks spread all along the line. Any part of the animal that touches the line is very likely to be snagged by the hooks. Baiji are often caught by the hooks either while chasing fish or by feeding on the hooked fish. Even among the baiji able to escape from the hooks, many are badly injured (Figure I:1,3). From our observations, most of the baiji show scars of snag hooks, and remains of big hooks are often seen in their stomachs. Rolling hooks damage the baiji's population size very seriously; it is the main cause of death. According to our statistics, 15 out of 33 deaths in the past 10 years were due to rolling hooks. These cases occurred during the dry season between November and March.

3. Incidental kills by river traffic.

River transportation is growing rapidly along the Chang Jiang. Just counting motorized vessels, it has doubled in size since the 1950s. Although the baiji uses its acoustic system to sense its environment, it often does not shy away from the noise of the motor and often is hit and killed by the propellers (Figure I:2,4). During dredging and rebuilding of the river, dynamite used to clear underwater rocks and siltations often kills baiji. For example, in February 1972, the River Traffic Department killed one whole group of baiji while doing their work in the Chang Jiang near Hung Hu County. The toll was 6, with 2 pregnant females.

4. Killing by inhabitants who have poor knowledge about protecting rare animals.

The baiji lives in the water. It has a very small population size, and inhabitants along the river do not recognize this animal or realize that it is a rare species that occurs only in our country. Therefore when the baiji beaches or swim close to the river bank, the inhabitants often use clubs or fishing spears to beat it to death.

Table 2 shows death statistics for 1973-1983. Unknown cause represents 1/6 of the total deaths. We may think of this as natural mortality. Other causes directly or indirectly due to human activities, which include explosion, rolling hooks, propellers, and beating etc., consist of 84.85% of the total deaths, representing 5/6 of the total mortality. It is the major cause for death. Human activities are dangerously affecting the existence of the baiji population. To take prompt measures in protecting this species from extinction is a emergency issue.

TABLE 2. 1973-1983 MORTALITY STATISTICS

CAUSE OF DEATH	DEATH TOLL	PERCENTAGE
EXPLOSION	5	15.15%
ROLLING HOOKS	15	45.45%
PROPELLER	2	6.07%
BEACHING	5	15.15%
BEATING	1	3.03%
UNKNOWN	5	15.15%
TOTAL	33	100.00%

Suggestions for conservation:

1. Establish an institution to manage conservation. the baiji is listed as a protected species but has not yet been effectively protected. Conservation of the baiji is critical, since currently the species is in imminent danger of extinction. We suggest that the government agencies protecting natural resources develop a conservation policy, by consulting with officials from provinces along the middle and lower reaches of the Chang Jiang, and set up an organization and manpower to enforce regulations.

2. Put emphasis on educating the public and generating public awareness. Choose inhabitants along the river, especially the fishermen, as the target audience and teach them about conservation in the hope that they will understand the ultimate meaning behind this issue and realize that killing the baiji will put it in a critical state.

3. Resolve conflicts between human productivity and conservation of the baiji. The rolling hooks are seriously destroying the baiji resource. Banning the use of rolling hooks should be considered seriously. When rebuilding the riverway, caution should be taken to ensure that baiji are directed away from the work area before explosives are used. Boat traffic should be slowed down when baiji are encountered.

4. Establish natural reserves along sections of the river. We suggest that sections number 5, 10, and 11 of the river where baiji occur frequently be designated as natural reserve sites. These sections are between Anqin and Heishazou (170 km); and between Dashinzou and Younglingyen (155 km). These sections should be manned with patrol boats and inspection agents to carry out conservation duties.

5. Develop more detailed research work in depth. It was rather late when research on the baiji started, and not much work has been done. We need to emphasize this type of research. Only based on in-depth research work can we arrive at more effective conservation and development. It is possible that unique capabilities and behavior of the baiji may be studied and utilized by human beings.

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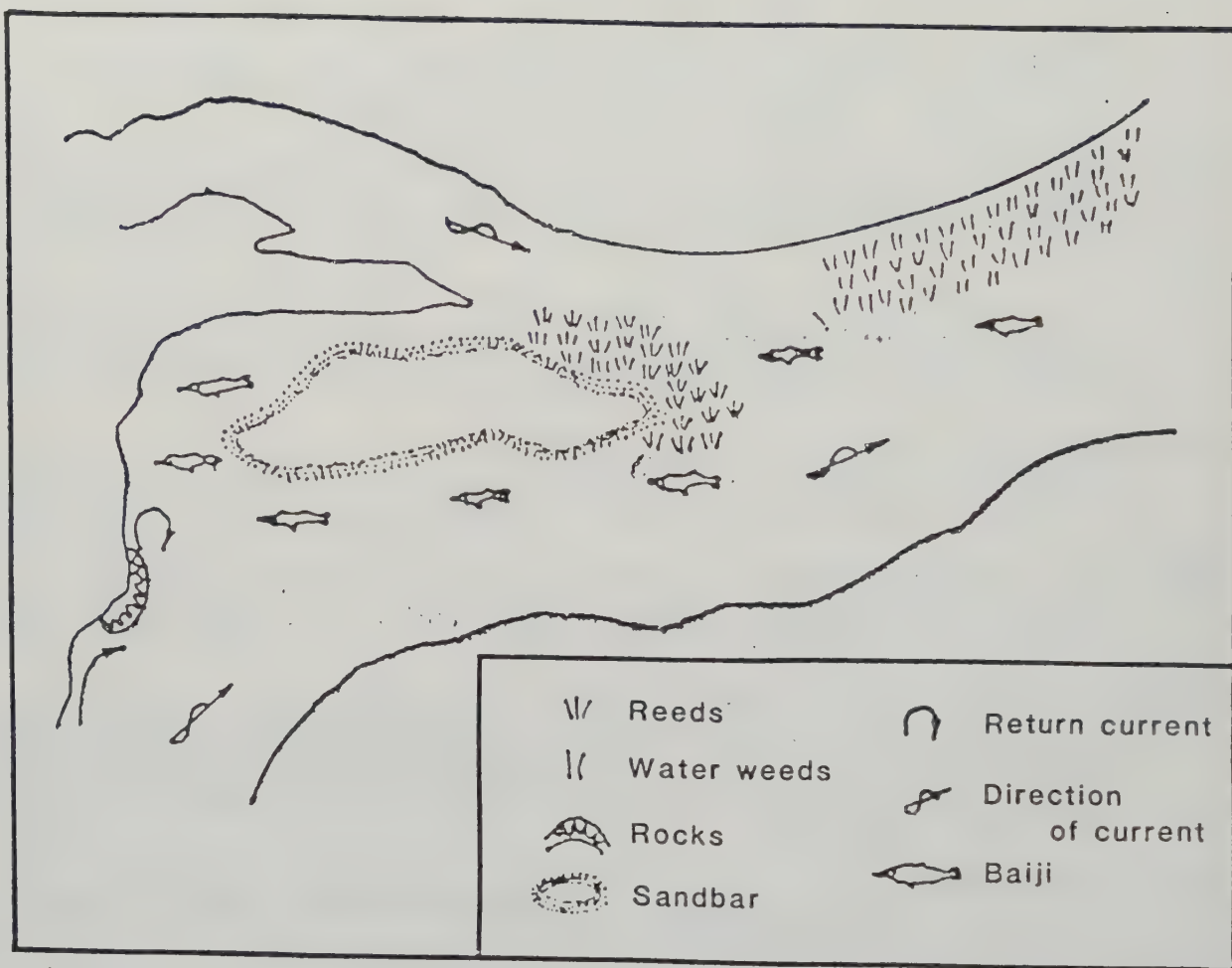


Figure 1. Habitat of the baiji.

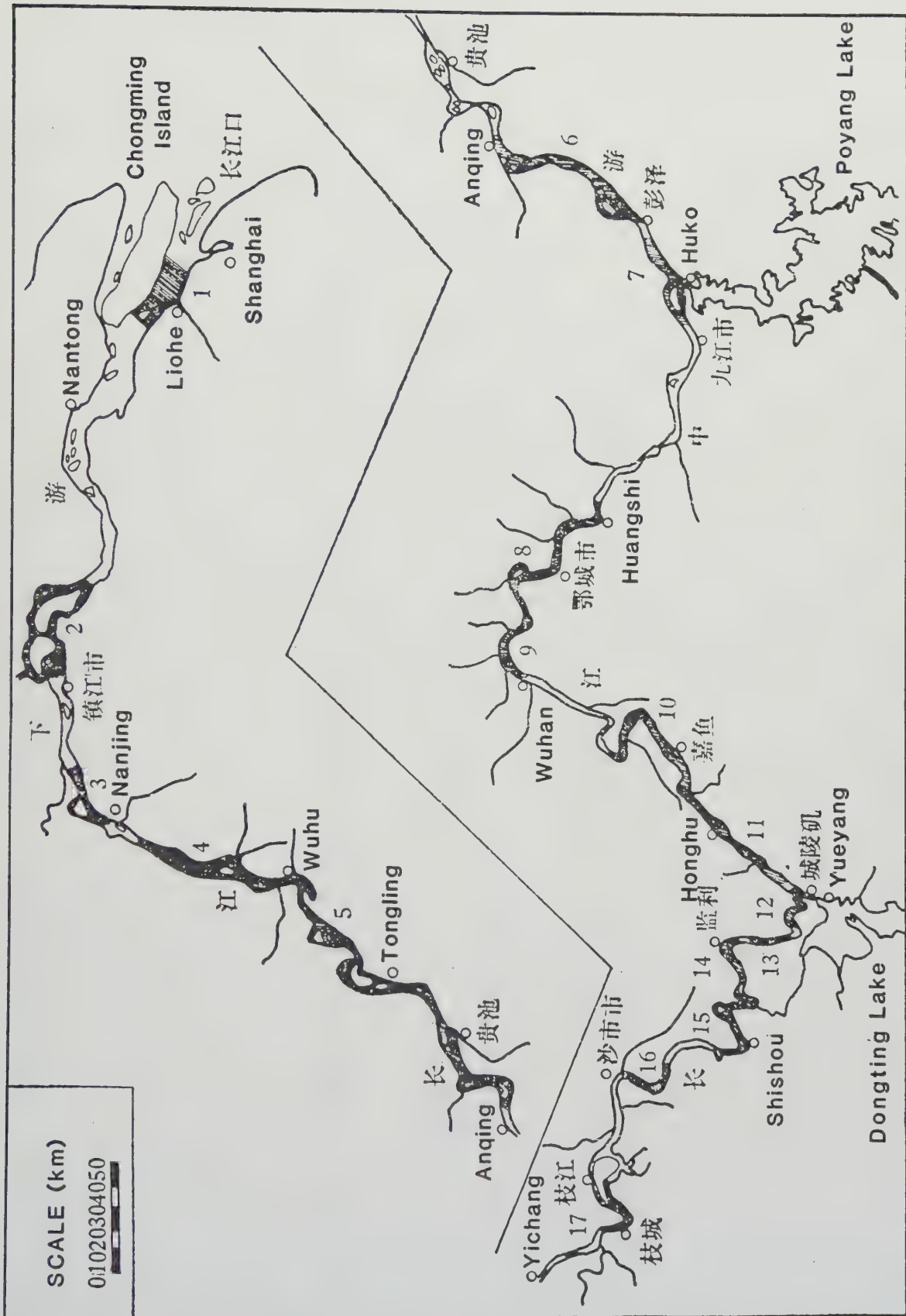


Figure 2. Distribution of the *biaji* in the middle (bottom) and lower (top) reaches of the Changjiang. Numbers indicate survey section.

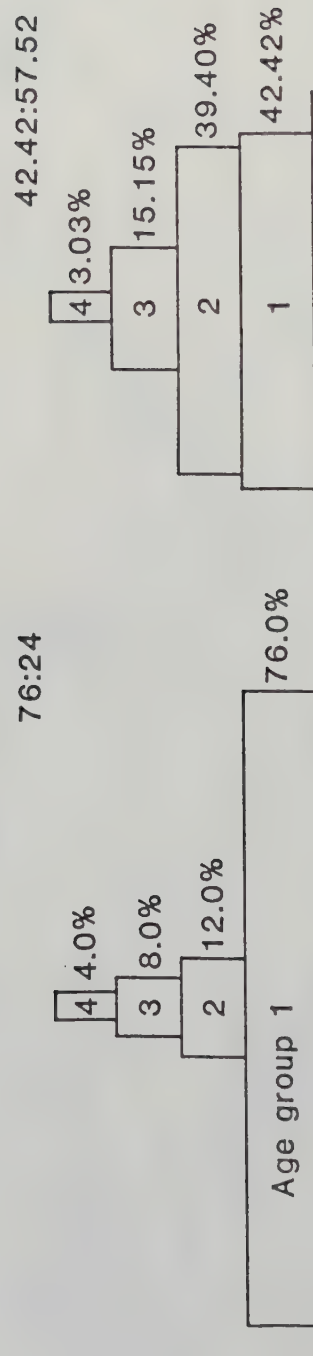


Figure 3. Age Structure of populations: left, high-production (Smith, 1974); right, baiji age structure.

